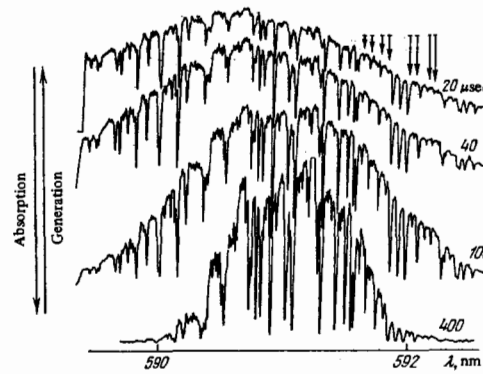
E. N. Antonov, V. G. Koloshnikov and V. R. Mironenko. In-Cavity Absorption Spectroscopy with a Continuous Dye Laser. The method of in-cavity absorption spectroscopy has been developed in a number of studies over the past five years[1-6]. The present paper deals with the dynamics of formation of the narrow gaps in the broadband spectrum generated by a continuous dye laser. These gaps are governed by absorption lines of the atmospheric air filling the laser cavity. The work was done with a laser using a free jet of a dye solution (Rhodamine 6G in ethylene glycol) and built in accordance with the scheme of [7]. A mechanical chopper was used to modulate the radiation of the Ar^+ pump laser, and the duration of the dye-laser pulses could easily be varied over a broad range. The broadband laser spectrum was registered with a spectrograph having a theroetical resolution of 2.7×10^5 and a linear dispersion of 1.6 Å/mm. The figure presents microphotograms of spectra registered at laser-pulse durations of 20, 40, 100, and 400 μsec. We see that the depths of the gaps corresponding to the above absorption lines increase with time. Theoretical estimates make it possible to relate the time constant of the increase in gap depth to the absorption coefficient in the particular line. This relation can be written

$$\tau = \frac{1}{ck(\omega)},$$

where c is the velocity of light and $k(\omega)$ is the absorption coefficient[8]. Thus, $k(\omega)$ can be calculated on the basis of time-constant measurements. The spectrograms were evaluated quantitatively for the eight atmospheric absorption lines marked by the arrows in the figure, and a comparison made between the theoretical predictions and the experimental results showed good agreement.



Wavelength, A	Identification according to [9]	k, cm^{-1}
5916.02±0.01	Not identified (masked by CrI)	$1.9 \cdot 10^{-7}$
5916.58±0.01	Atmospheric H_2O	$2.8 \cdot 10^{-7}$
5917.38±0.01	Same	$3.5 \cdot 10^{-7}$
5918.01±0.01	Atmospheric	$1.7 \cdot 10^{-7}$
5919.64±0.01	Atmospheric H_2O	$3 \cdot 10^{-6}$
5920.16±0.01	Atmospheric	$1 \cdot 10^{-7}$
5921.15±0.01	"	$1.1 \cdot 10^{-7}$
5921.66±0.01	"	$1.2 \cdot 10^{-7}$

The results of the measurements appear in the Table. The measured values of the absorption coefficients range from 1×10^{-7} to 3×10^{-6} cm^{-1}. This experimental method, working with a continuous-duty laser and a modulator, makes possible quantitative measurements of absorption coefficients down to $k \approx 10^{8}$ cm^{-1}. Optimization of the system parameters would make possible quantitative absorption-coefficient measurements in the range $k \approx 10^{-10}$ cm^{-1}.

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